United States Patent [19]

Okabe et al.

[11] **4,089,263**

[45] **May 16, 1978**

[54] **IMPACT PRINTER**

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[73] Assignee: **Copal Company Limited**, Tokyo, Japan

[21] Appl. No.: **767,618**

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[30] **Foreign Application Priority Data**

Feb. 12, 1976 Japan ..... 51-15264[U]

[51] **Int. Cl.**[2] **B41J 9/10**; B41J 9/36

[52] **U.S. Cl.** **101/93.33**; 400/152; 400/157.2

[58] **Field of Search** 101/93.30, 93.31; 197/49

[56] **References Cited**

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[57] **ABSTRACT**

An impact printer in which a printing drum having a plurality of lines each containing different characters is associated with printing hammers. The printing hammers are driven into contact with the characters by a driving shaft having a driving projection thereon. The driving projection is separated into driving projection sections which are axially and radially displaced along the driving shaft. Each section will selectively engage different printing hammers so that all hammers will not operate at once for the same characters. The characters in the lines are also displaced angularly of the printing drum so that some of the characters in one line will be printed responsive to one driving projection and the other characters in the one line will be printed in response to the other driving projection section.

4 Claims, 4 Drawing Figures

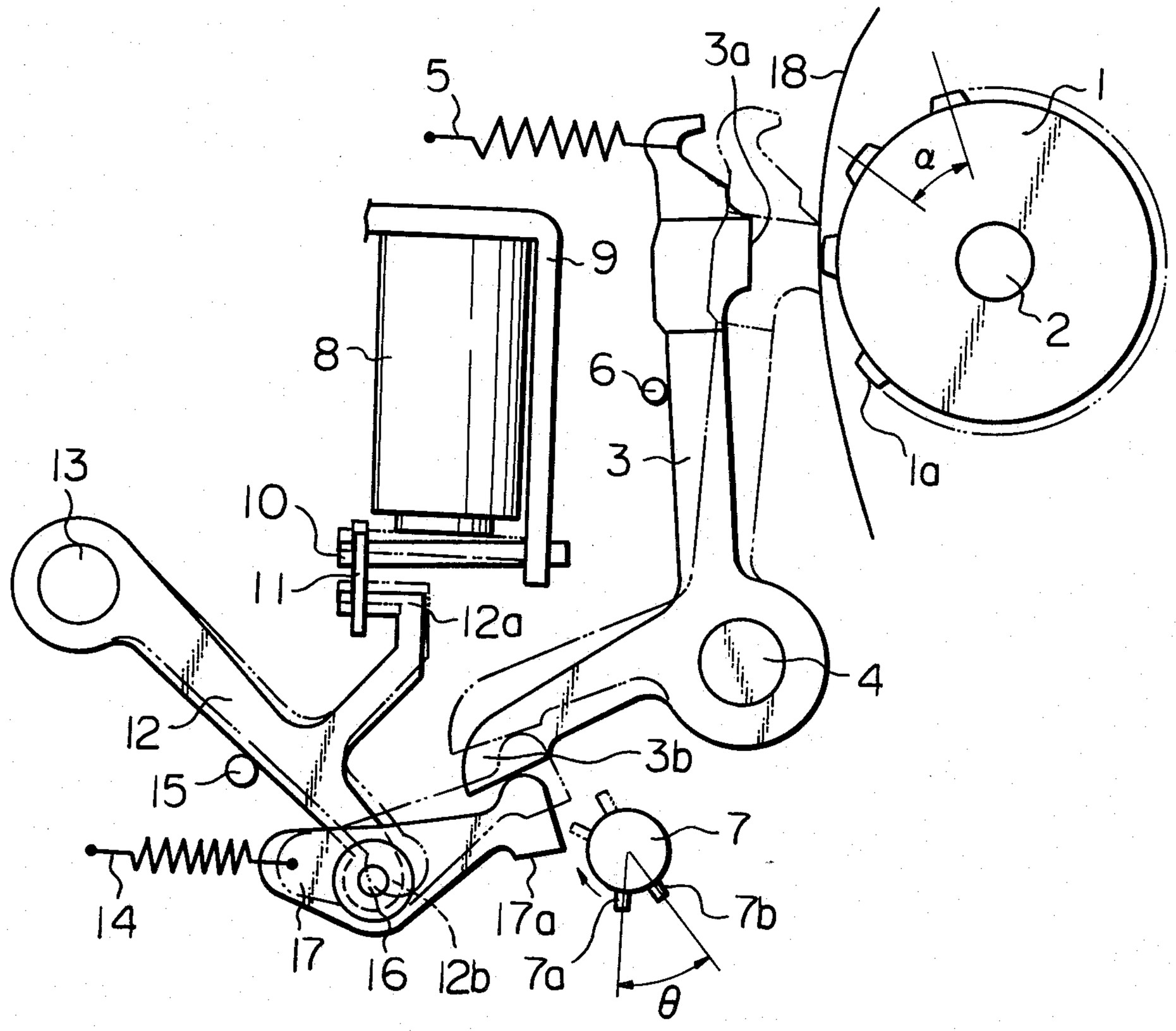


Fig. 1

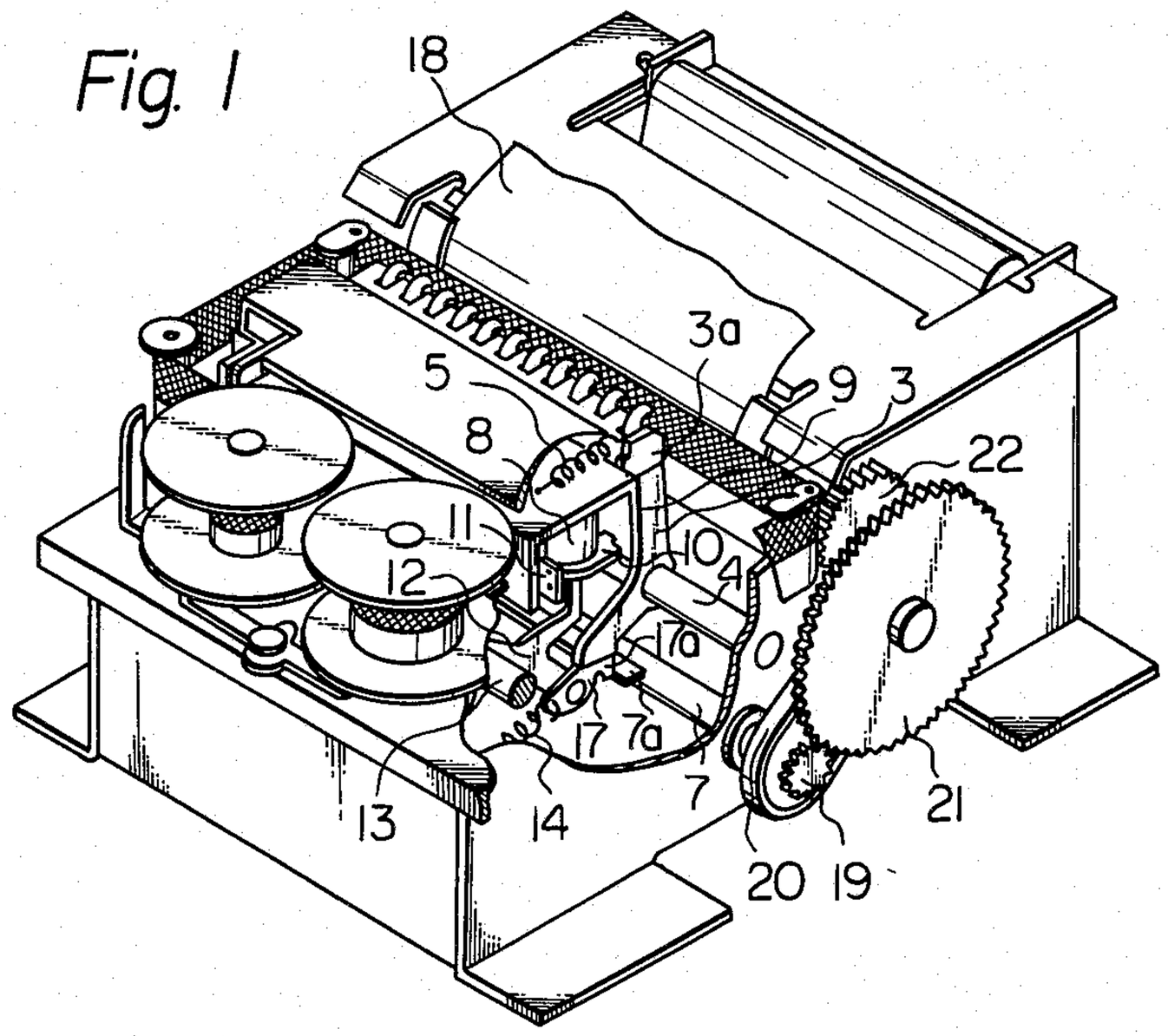


Fig. 2

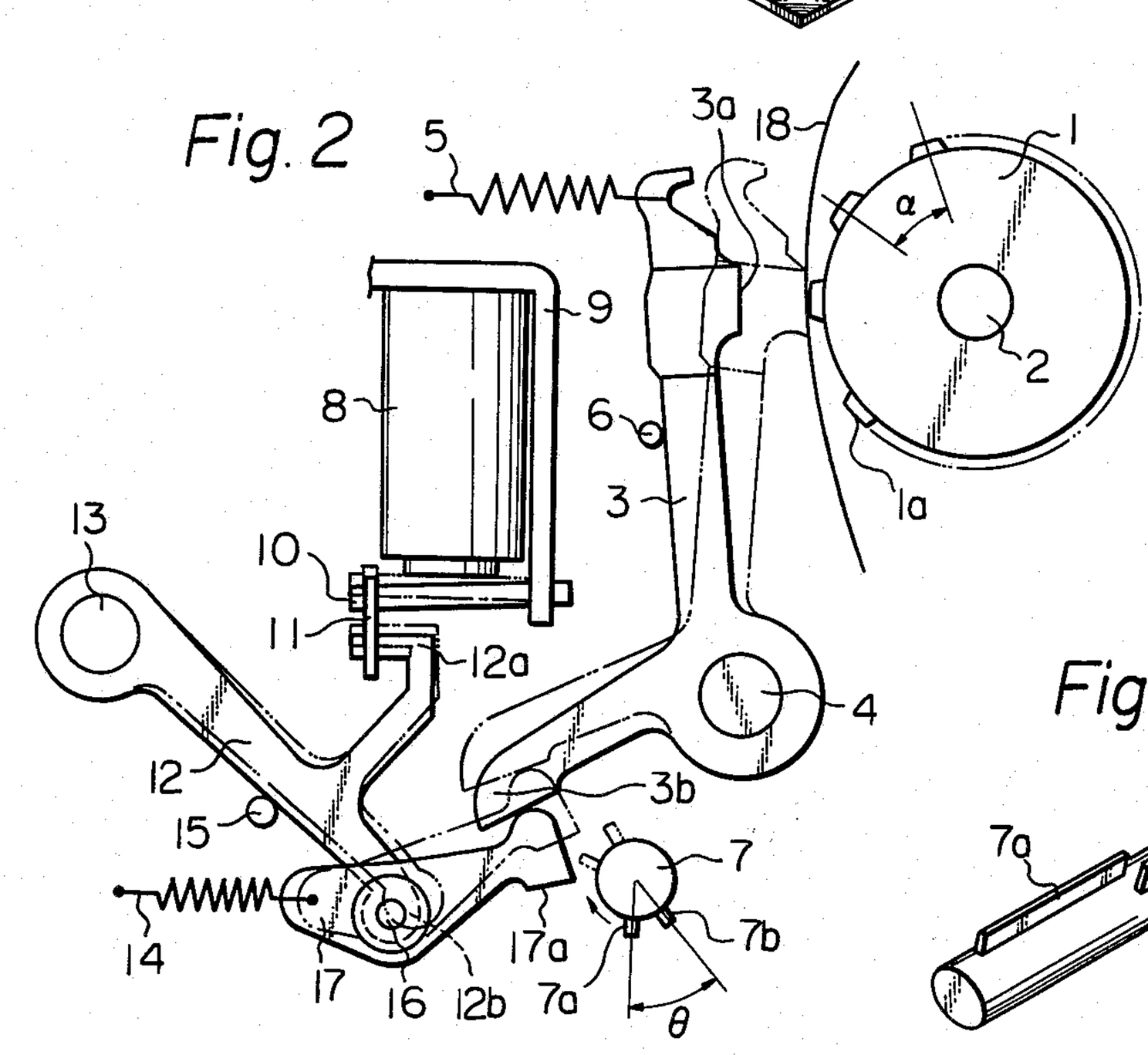
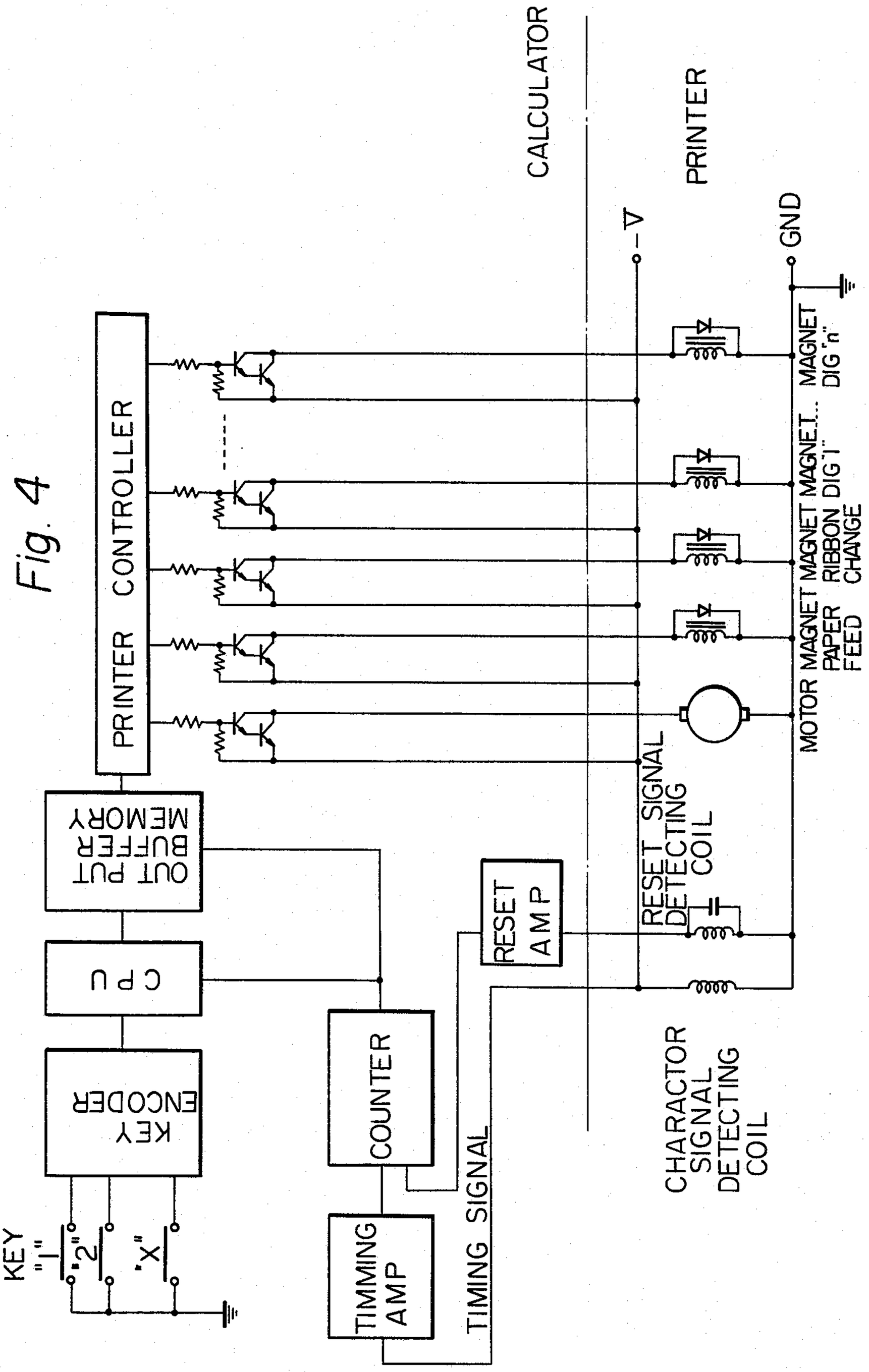


Fig. 3

Fig. 4


CALCULATOR
PRINTER
-V
GND
CONTROLLER
PRINTER
OUT PUT BUFFER MEMORY
C P U
KEY ENCODER
COUNTER
RESET AMP
RESET SIGNAL DETECTING COIL
MOTOR MAGNET PAPER FEED
MAGNET DIG "n"
MAGNET DIG "1"
MAGNET
RIBBON CHANGE
CHARACTOR SIGNAL DETECTING COIL
TIMMING AMP
TIMING SIGNAL
KEY
"1"
"2"
"X"

IMPACT PRINTER

BRIEF SUMMARY OF THE INVENTION

The impact printer has a rotating printing drum bearing a plurality of axially extending rows of printing characters circumferentially arranged on the peripheral surface of the drum, the characters in any one row being identical to each other but the characters in the respective row being different from those in other rows, a driving shaft adapted to be driven at a speed in synchronism with the drum so that it rotates one revolution during the time until the succeeding row is brought to the printing position of the printer for the printing operation after the preceding row has been moved thereto for the printing operation and moved away therefrom, printing hammers each belonging to the respective character in each row for printing the character at the printing position when actuated, control members each belonging to the respective printing hammer for actuating the same when driven, the driving shaft having driving projection means for driving the respective control members, the control members being normally held apart from the driving projection means so that it is inoperative by the driving projection means but, when the operator manipulates the printer for the required printing, the control members are brought to the positions at which they are driven by the driving projection means thereby permitting the required printing operation to be effected. In order to reduce the instantaneous excessive power as is required for the simultaneous printing of the same characters in one row of the printing resulting in too light printing, the driving projection means of the driving shaft is divided into at least two portions shifted their angular phase slightly from each other so that some of the control members are driven in retard of the actuation of the remainder of the control members so as to avoid the simultaneous excessive power for the printing operation while the location of the printed characters in one row is substantially held in alignment with each other.

BACKGROUND OF THE INVENTION

The present invention relates to an impact printer and, more particularly, to an impact printer in which the instantaneous excessive power required for the actuation of the printing hammers is greatly reduced.

In a so-called impact printer having a rotating drum bearing thereon a plurality of axially extending rows of printing characters each of which rows consists of a plurality of the same characters with each other but different from those in other rows, printing hammers each belonging to the respective character in each row and kicking members adapted to be rotated at all times during the operation of the printer each belonging to the respective hammer, the hammers are selectively brought into operative position by the kicking members upon manipulation of the printer for the required printing operation so that the hammers are struck by the kicking members thereby permitting the required printing to be given in the recording paper by the actuation of the hammers.

In such a type of the impact printer, the hammers are selectively struck according to the manipulation of the printer when the each selected row of the required characters passes the printing position of the printer at which the respective hammer strikes the drum with the paper held therebetween during one revolution of the printing drum thereby completing the printing of one row.

Therefore, in case all the characters to be printed in one and the same row are the same with each other, all the printing hammers must be struck simultaneously by the kicking members for the respective printing hammers so that instantaneous excessive power is required for properly actuating the respective hammers otherwise the striking force of the hammers is made weak resulting in light printing of the characters.

SUMMARY OF THE INVENTION

The object of the present invention is, therefore, to avoid the above described disadvantages of the prior art impact printer and to provide a novel and useful impact printer of the type as described above in which the power required for the proper printing is widely reduced even though all the characters to be printed in one and the same row are the same with each other without deteriorating the quality of the printing obtained.

The above object is achieved in accordance with the present invention by the provision of an impact printer in which the kicking members are shifted in their angular phases slightly from each other thereby avoiding the simultaneous operation of the hammers even though all the characters to be printed in one row are the same with each other while the alignment of the printed characters in one row is substantially held properly.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a general perspective view showing an impact printer embodying the present invention;

FIG. 2 is a schematic side view showing the main portions of the printer shown in FIG. 1;

FIG. 3 is a perspective view showing the kicking members of the present invention; and

FIG. 4 is a block diagram showing the control circuit of the printer shown in FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 showing the impact printer of the present invention, the printing drum **1** (not shown in this figure but shown in FIG. 2) is integrally attached to a shaft **2** (FIG. 2) to which a gear **22** is secured which gear **22** is driven together with the printing drum **1** at all times during the operation of the printer through a gear train including a pinion **19**, a gear **21** and a gear (not shown) integral with the gear **21** by a belt **20** which is driven by a motor not shown. The printing drum **1** bears a plurality of axially extending rows of printing characters **1***a* (FIG. 2) arranged circumferentially on the peripheral surface of the drum with the angular phase difference α held between the adjacent rows as shown in FIG. 2. All the characters **1***a* in one row are identical with each other but different from those in other rows.

Printing hammers **3** each belonging to the respective characters in each row are rotatably supported by a shaft **4** secured to the frame of the printer.

Each of the printing hammers **3** is selectively actuated to strike the printing drum **1** for the printing operation by the respective control means consisting of a control lever **17** and a select lever **12** to which the control lever **17** is pivoted, the select lever **12** per se being pivoted to a shaft **13** secured to the frame of the printer. Thus, each of the control means is so actuated that, upon manipulation of the printer to issue the printing

demand signal, selected one or ones of electromagnets **8** each belonging to the respective control means are energized so as to bring the corresponding control levers **17** into the positions at which the same are driven or kicked by driving projection means or kicking members *7a* secured to a driving shaft **7** to which the pinion **19** is integrally secured so as to drive the shaft **7** at all times in synchronism with the printing drum **1** during the operation of the printer at a speed at which the driving shaft **7** is rotated one revolution during the time the drum **1** is rotated by the angle of α, i.e. during the time until the succeeding row of the drum reaches the printing position at which the printing hammer **3** strikes the drum **1** after the preceding row has been struck by the printing hammer at the printing position, thereby effecting the printing by the hammers onto the recording paper **18** interposed between the drum **1** and the hammers **3**.

The timing of the actuation of the control levers **17** by the driving projection means *7a* of the driving shaft **7** is so selected that the hammers strike the selected row of the printing drum **1** which is just brought to the printing position during the rotation of the drum **1**.

Now, the present invention will be described in detail with reference to FIGS. **2** and **3**.

As described previously, the printing drum **1** bearing thereon a plurality of rows of characters **1***a* with the angular phase α held between the adjacent rows is driven by the shaft **2** secured thereto. Each of the printing hammers **3** corresponding to the respective character in each row is rotatably supported by the shaft **4** and is formed with a striking surface **3***a* for striking the drum **1** and an arm **3***b* adapted to be driven by the control lever **17** when it is brought to the operative position as described later. Each of the hammers **3** is energized by a spring **5** in the counterclockwise direction in FIG. **2** and held by a stopper **6** at a position at which the striking surface **3***a* is held apart from the periphery of the printing drum **1**.

The driving shaft **7** having the driving projection means is rotated in synchronism with the drum **1** as previously described.

Each of the select levers **12** pivoted on the shaft **13** is formed with an arm **12***a* connected through a connecting lever **11** to an armature **10** of the electromagnet **8**, the armature **10** being swingably supported by a frame **9** of the printer so that, when the magnet **8** is energized the lever **12** is attracted in the counterclockwise direction in FIG. **2**. The control lever **17** is pivoted to the respective select lever **12** by a pin **16** is formed with an abutment surface **17***a* adapted to cooperate with the driving projection means *7a* of the driving shaft **7**, the side edge opposite to the abutment surface **17***a* being adapted to strike the arm **3***b* of the printing hammer **3**, when actuated. Each of the control levers **17** is energized by a spring **14** so as to be biased toward the left in FIG. **2** together with the select lever **12** and stopped by a stopper **15** so that each of the control levers **17** is normally held at a position at which the abutment surface **17***a* is held out of the path of movement of the driving projection means *7a* of the driving shaft **7**.

Thus, when the electromagnet **8** is energized, the select lever **12** is moved in the counterclockwise direction together with the control lever **17** against the action of the spring **14** so that the abutment surface **17***a* is moved into the path of movement of the driving projection means *7a* so as to be struck by the projection means *7a* for striking the arm **3***b* of the printing hammer **3** thereby effecting the printing by the printing hammer.

In such a construction, if all the characters to be printed in one and the same row of the printing is the same with each other, all the printing hammers **3**, and, hence, the control levers **17** and the select levers **12** must be actuated simultaneously by the simultaneous energization of all the magnets **8** because the characters in one row are identical to each other with the characters in each row being different from other rows, thereby requiring instantaneous excessive power or rendering the striking force of the hammers **3** to be weak resulting in too light printing quality.

In accordance with the present invention, in order to avoid such excessive power, the driving projection means *7a* is divided into at least two sections *7a, 7b* angularly shifted from each other by a slight angle θ so that the control levers **17** and, hence, the printing hammers **3** belonging to the section *7b* of the driving projection means are actuated slightly in retard of the actuation of those belonging to the section *7a* so as to avoid the simultaneous actuation of the hammers **3** even though all the characters to be printed in one row are the same with each other and reduce the peak of the power required for such printing.

In accordance with the present invention, the numbers of the sections *7a, 7b* may be made more than two so as to further average the power.

In accordance with the present invention, the arrangement of the characters in each row belonging to the section *7b* may be angularly shifted from those belonging to the section *7a* correspondingly to the phase angle θ between the sections *7a, 7b,* so that the characters printed in one row can be strictly in alignment with each other.

In operation, the drum **1** and the driving shaft **7** are first rotated. Upon issuance of the printing demand signal by the manipulation of the printer, the selected magnets **8** are energized each time immediately before the respective selected row of characters reaches the printing position, so that the armatures **10** are attracted to actuate the respective select levers **12** so as to bring the control levers **17** into operative position by the driving projection means *7a, 7b* of the driving shaft **7**, thereby permitting the respective printing hammers **3** to strike the selected row of characters with the paper **18** interposed therebetween for effecting the desired printing operation. Since the sections *7a* and *7b* of the driving projection means are angularly shifted from each other, the instantaneous excessive power as required in case all the characters to be printed in one row are the same with each other requiring the simultaneous actuation of all the hammers is greatly reduced.

Therefore, the load to the driving motor is reduced enabling the use of small capacity motor while too light printing quality is positively avoided.

FIG. **4** shows an example of the control circuit for use with the printer described above.

Briefly speaking, upon manipulation of KEYs, the KEY ENCODER (usually made of diode matrix) encodes the input from the KEYs and issues an output to CPU (Center Processing Unit) for the operation thereof.

The output of CPU is received by OUTPUT BUFFER MEMORY so as to memorize the printing data in conformance with the operation of the printer.

The PRINTER CONTROLLER receives the output of data signals from OUTPUT BUFFER MEMORY

and converts the data signals to the printer driving signals so as to be amplified by DRIVER TRANSISTORs so that the driving of the printer is thereby made possible.

On the other hand, CHARACTER SIGNAL DETECTING COIL is adapted to issue character timing pulses or signals by sensing the magnetic pieces provided on a timing belt, or the belt **20** shown in FIG. **1** and the output pulses are amplified by TIMING AMP so that "H" and "L" logic outputs are generated for actuating COUNTER so as to issue address signals. The address signals are fed to CPU and OUTPUT BUFFER MEMORY to control the actuation thereof.

MOTOR and MAGNETs for paper feed and carbon ribbon change and selection of each character, for example, the digit DIG "1" to "*n*" corresponding to the number of characters in one row, are controlled by the DRIVER TRANSISTORs for the desired operation of the printer.

Since the control per se is not the subject matter of the present invention, the detailed description thereof is omitted.

We claim:

1. Impact printing having

a rotating printing drum bearing a plurality of axially extending rows of printing characters circumferentially arranged on the peripheral surface of said drum, the characters in any one row being identical to each other and different from the characters in other rows,

a driving shaft adapted to be driven at a speed in synchronism with said drum,

printing hammers each belonging to the respective character in each row for printing a selected character at the printing position of said printer during the rotation of said drum when said hammer is actuated,

control levers each belonging to the respective printing hammer for actuating the same when driven,

said driving shaft being provided with driving projection means for driving the respective control levers in such a manner that the same are actuated in synchronism with the arrival of the selected row of said drum at said printing position during the rotation of said drum,

said control levers being normally held apart from said driving projection means so as to be inoperative by said driving projection means but, upon manuipulation of said printer for the required printing operation, selected one or ones of said control levers being brought to positions at which they are driven by said projection means thereby permitting required printing operation to be effected,

wherein the improvement comprises:

said driving projection means being divided into at least a first and a second section,

said first and said second sections being slightly shifted angularly around said shaft from each other,

said first section extending along a first axial portion of said shaft,

said second section extending along a second axial portion of said shaft, said section each having a length a least equal to the width of two adjacent rows,

said first and said second portions being free of any other section along the same axial portion thereby avoiding excessive power required for the actuation of said hammers even though the same characters in one row are to be printed simultaneously while the printed characters in each row is substantially held in alignment with each other.

2. Printer according to claim **1**, wherein the arrangement in each row of the respective characters is so selected that characters corresponding to one of said sections of said driving projection means are correspondingly shifted angularly from the characters corresponding the remaining section so that the printed characters in each row is held strictly in alignment with each other.

3. Printer according to claim **1**, wherein

said control levers are all uniformly associated with said driving shaft.

4. Printer according to claim **3**, wherein

said printer has magnets, armatures and select levers coupled with said control levers, and said select levers are uniformly aligned with each other and with said sections; and,

said sections each extend partially along said driving shaft without overlapping each other, said sections being angularly displaced from each other so that one of said sections will engage a first group of said control levers and the other of said sections will engage a second group of said control levers in response to energization of said associated magnets.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 4,089,263
DATED : May 16, 1978
INVENTOR(S) : Katsuhiko Okabe, et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 5, Line 14 change "MAGNETs" to --MAGNETS--

Line 18 change "TRANSISTORs" to --TRANSISTORS--

Claim 1:

Col. 6, Line 14 change "section" to --sections--

Line 15 change "a" to --at--

Line 16 change "rows" to --characters--

Signed and Sealed this

Second Day of *October 1979*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

LUTRELLE F. PARKER
Acting Commissioner of Patents and Trademarks